

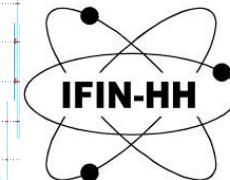
# TRD-2D

## mCBM 2022 data taking campaign

### Prototype construction

*Alex Bercuci for the TRD-2D group*

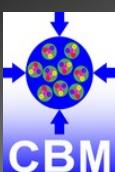
- A. Bercuci
- V. Catanescu
- M. Petris
- M. Petrovici
- L. Radulescu
- C. Schiaua
- C. Andrei
- V. Aprodu
- G. Caragheorgheopol
- V. Duta
- A. Nan
- A. Pop
- L. Prodan
- A. Radu
- G. Stoian
- M. Tarzila



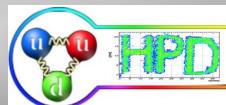
[www.ifin.ro](http://www.ifin.ro)



**DFH weekly meeting**  
**18<sup>th</sup> March 2022**



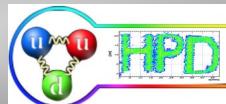
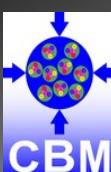
# Overview



- *In the previous meeting (25.10.2021)*
  - A detailed description of **the detector and its design performances** were presented as they are included in the TRD **TDR Addendum**.
  - First **results from mCBM July 2021** data taking campaign were shown.
- *In this meeting (18.03.2022)*
  - Final TRD2D chamber - **Prototype construction** status
  - Further data taking at SIS18 with the **mCBM; (dry runs, CR, C-Ni)**
  - Software development; **(monitoring, reconstruction, simulations)**

Details are discussed using the following communication channels

- TRD-2D @ DFH
- TRD @ CBM
- mCBM operation
- mCBM Data Analysis & Simulations
- DAQ
- CBM Redmine
- CERN Mattermost
- CBM GitLab



# Prototype construction

## Components

- entrance window 2 pcs  
(1<sup>st</sup> ready, 2<sup>nd</sup> prepared) (A.Radu)
- chamber ledges (final touches)
- wire comb 1.5 mm (A.Radu/V. Duta)
- wire comp 3 mm (M. Petris)
- araldite, Anode w, Cathode w (M. Petris)
- backplane components (D. Bartos)

## Construction toolbox

- Wire winding machine (C. Andrei)
- Wire tension measuring device  
(C. Andrei)
- Chamber mounting device  
and technology (V.Duta)

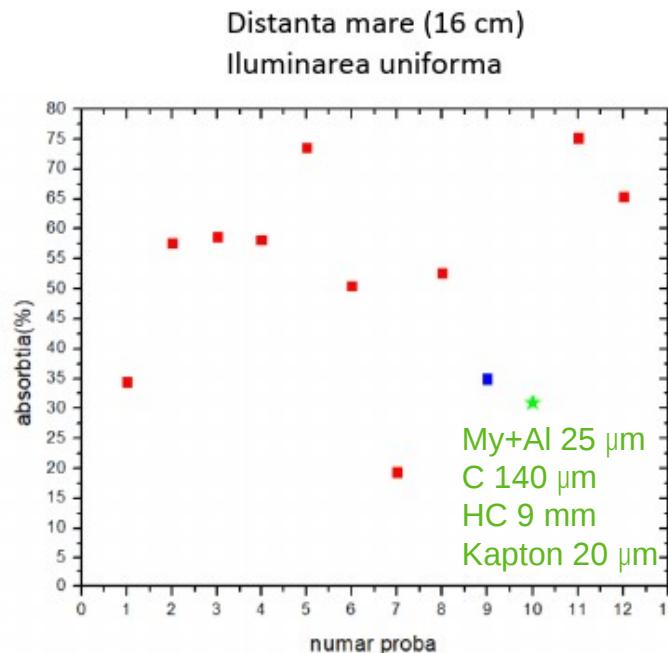
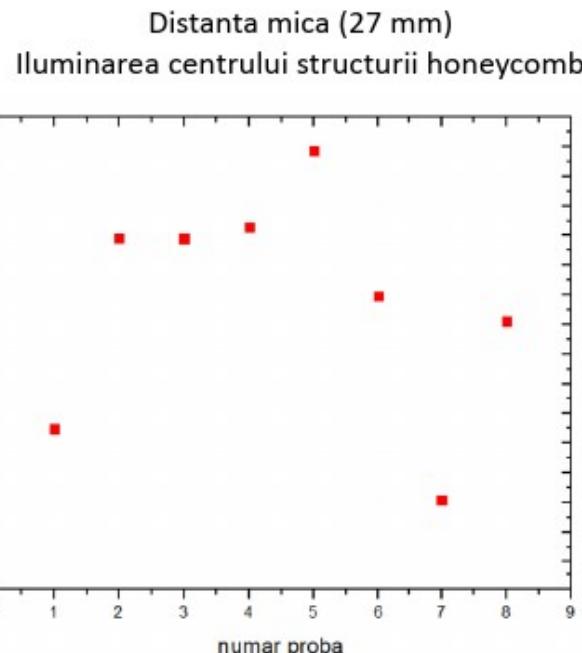
## aob

- Continuous filling  
and emptying list

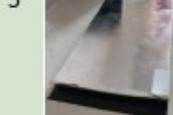
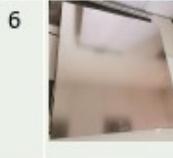
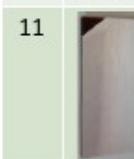
## Quality Assurance Tests

- pad-plane connectivity (V.Aprodu, L.Prodan)
- mechanical and absorption tests  
for the entrance window (D.Dorobantu)
- ledges mechanical tolerance, gas box (L.Radulescu)

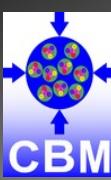
## Determinarea coeficientului de absorbție cu ajutorul TRD



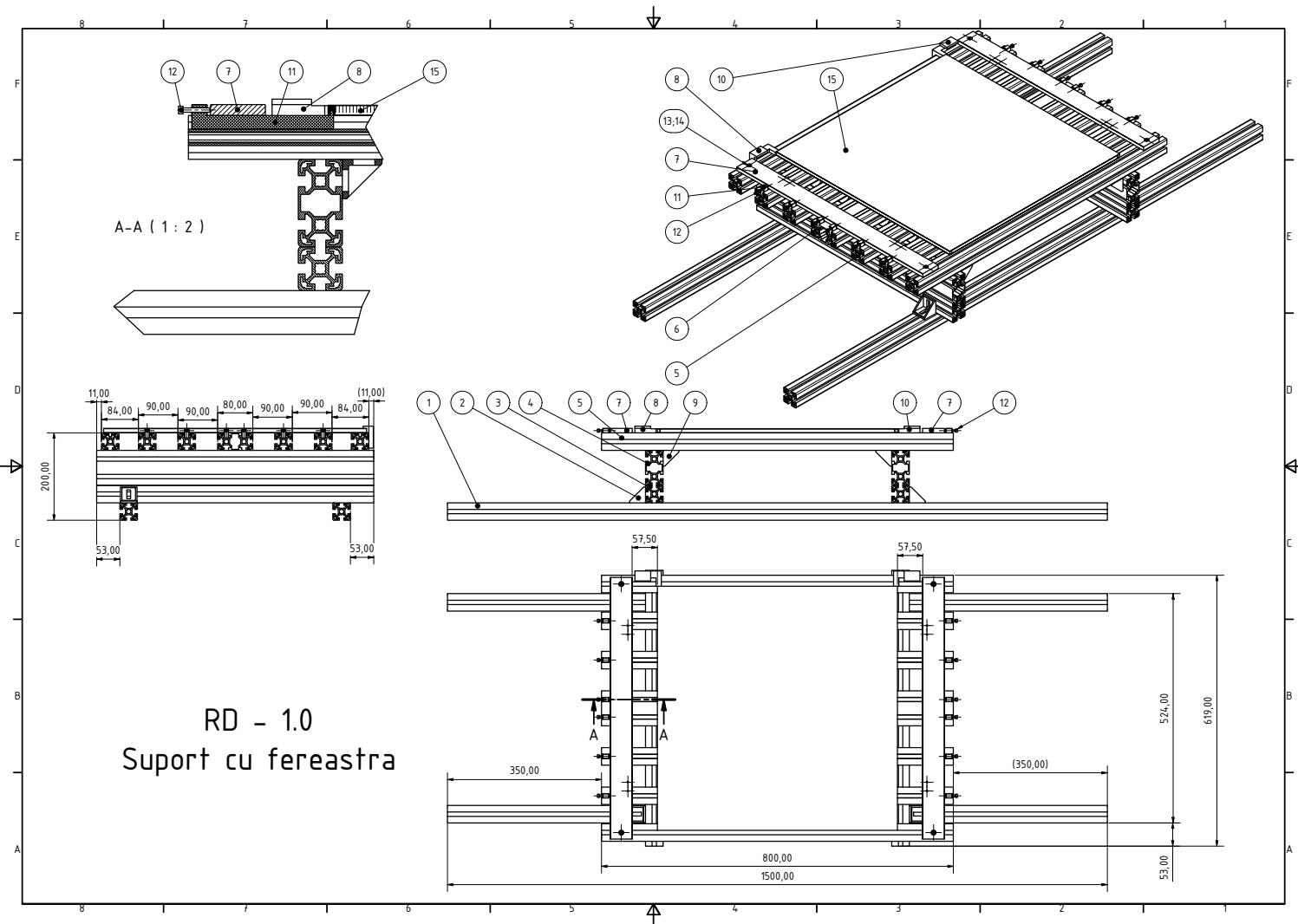
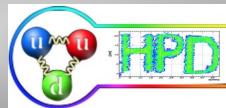
Legenda

Nr.	Probă	Nr.	Probă
1		5	
2		6	
3		7	
4		8	
11		12	

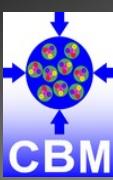
D. Dorobantu et al., [Studii de optimizare a ferestrei de intrare a detectorului de radiație de tranziție pentru experimentul CBM](#)  
 D. Dorobantu et al., *Entrance window for the TRD-2D chambers for the CBM experiment*, CBM Progress Report 2021, in preparation



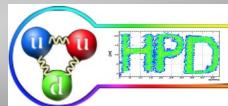
# Chamber mounting device



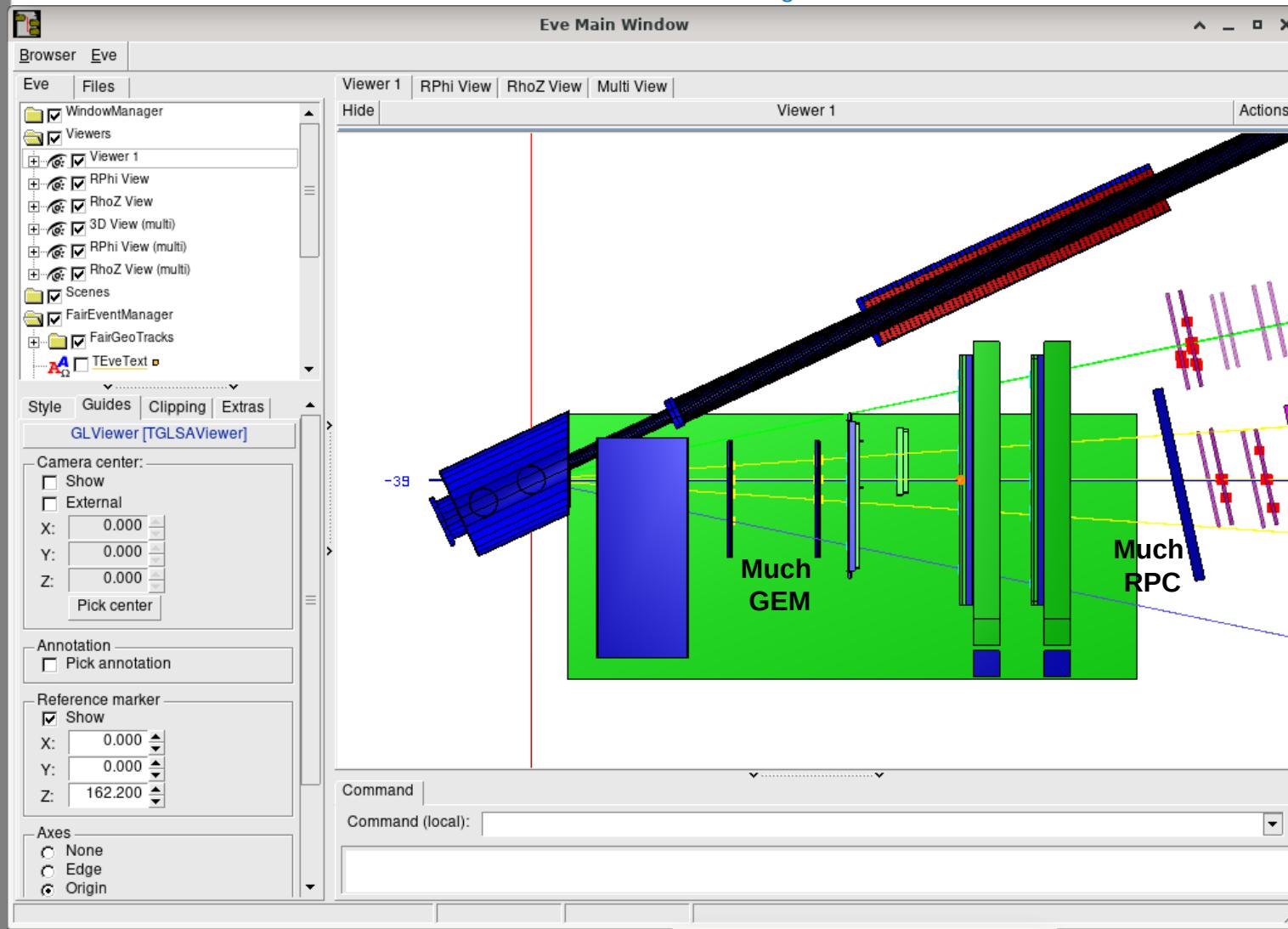
V. Duta et al., Rama Detector

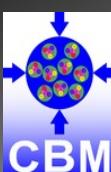


# mCBM 2022

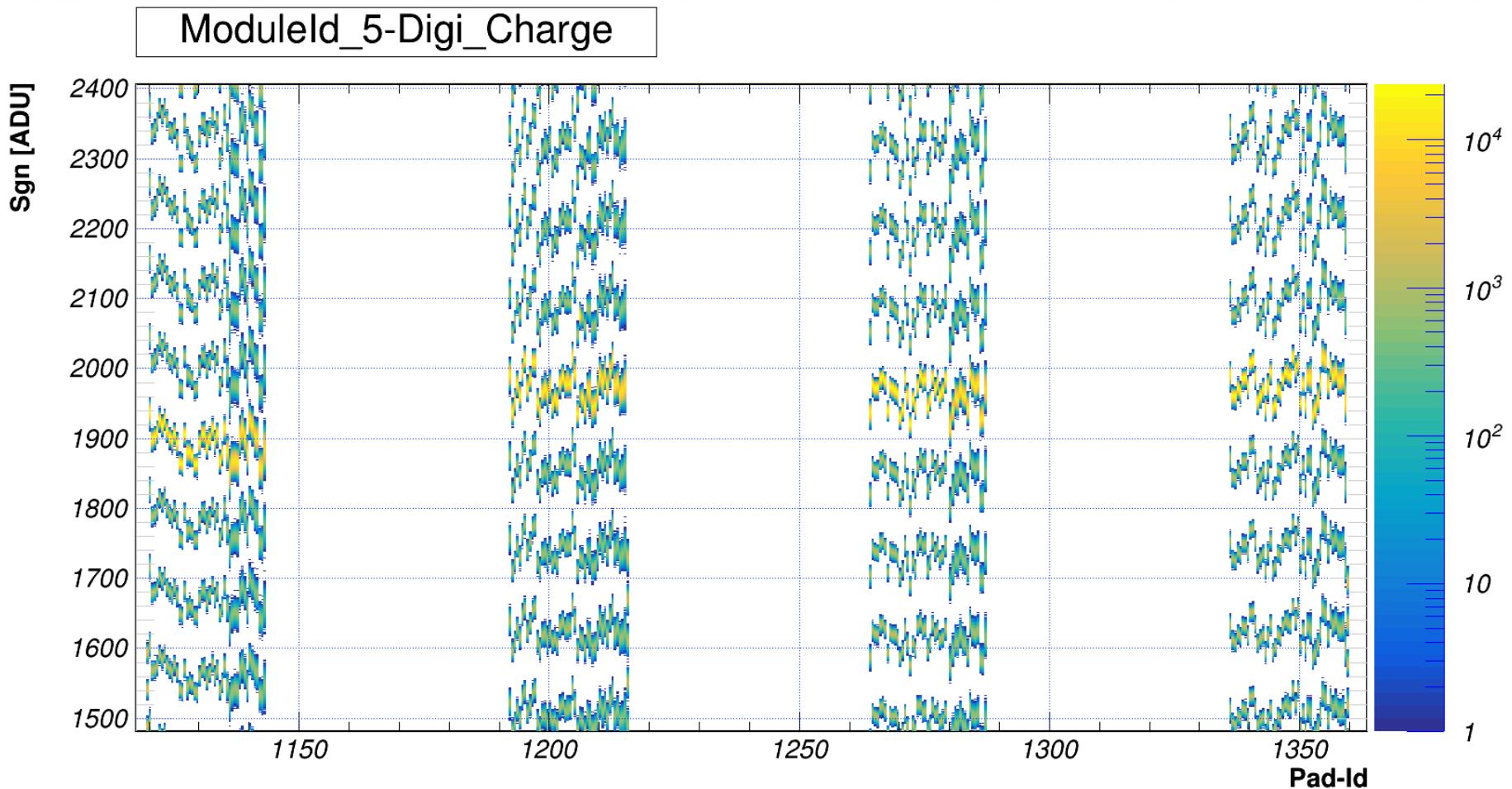
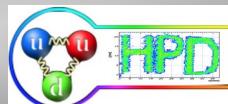


Provide TRD v22d as of March 9th for Carbon beam data taking



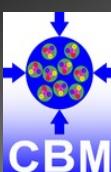


# Dry runs (2046)

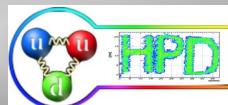


## Pulser calibration

- 2 FASPRO, FASP ids 0 – 11
- Signal 600 – 2000 / 100 mV



# Cosmic Rays (2006)



Channels  x ? @ ≡ A

CBM +

CHANNELS

- devel04-access-synchro...
- mCBM analysis
- mCBM beamtime**
- mCBM Data Analysis Gro...
- Off-Topic
- Town Square

**mCBM beamtime** ☆

52 1 Dry runs and cosmics from 06 Dec. 22 | Beamtime Indico | Redmine | R...

March 05

**Norbert Willi Herrmann** 8:12 AM

Time correlation after 1 night (~10h) of cosmic running requesting events with hits on 4 different Tof counters

Screenshot\_20220305\_0... PNG 14KB ↓

Screenshot\_20220305\_0... PNG 14KB ↓

Screenshot\_20220305\_0... PNG 15KB ↓

Screenshot\_20220305\_0... PNG 14KB ↓

**Christian Sturm** 11:10 AM

wow ... many thanks!

Although I have the feeling that cosmics come especially in our cave while we are not watching ... a kind of a new measuring process 😊

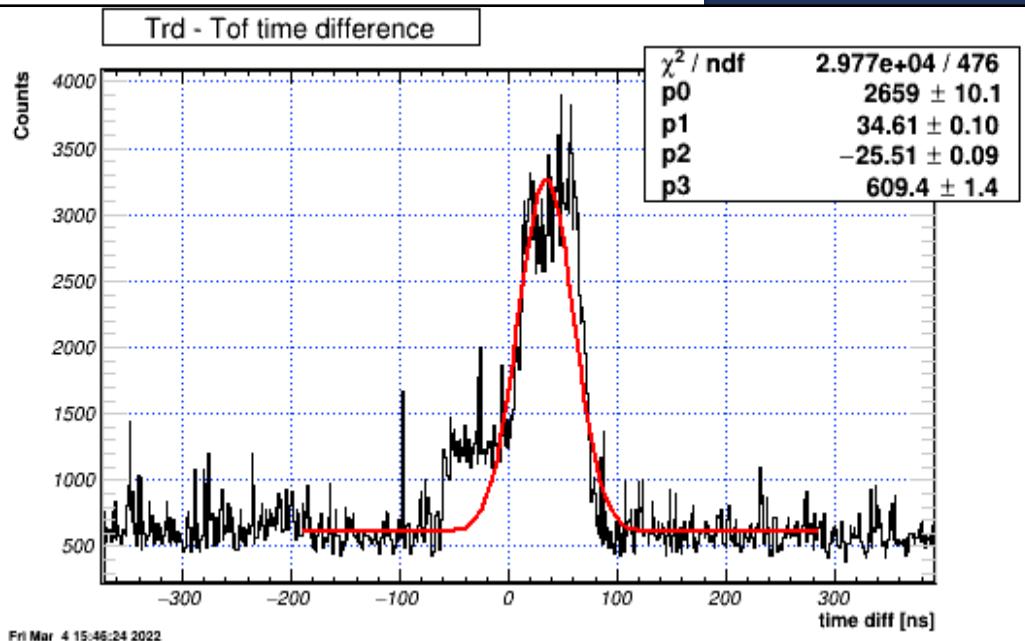
Please ramp down the HV of all counters - Norbert and Ingo will work inside the cave !

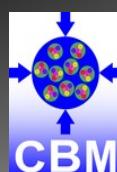
**Adrian Weber** 1:37 PM

I am not at hime and can not ramp down.

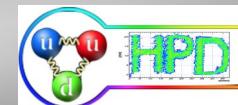
Write to mCBM beamtime Help

N. Herrmann, Online monitoring





# C – Ni @ 1.96 AGeV on 10.03.2022 (2060, 2061, 2062, 2064, 2065)



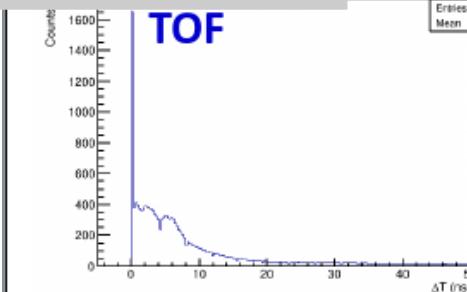
all except PSD, GEM2

- 2060 thick target
- 2061 thin target
- 2062 empty

all except PSD, TRD partially

- 2064 thin target
- 2065 thin target

borrowed from A. Toia



Line of event

hTDiffkTof

Entries

1.639022e+07

Mean

9.528

ΔT of kSts digis to seed time of event

hTDiffkSts

Entries

4256882

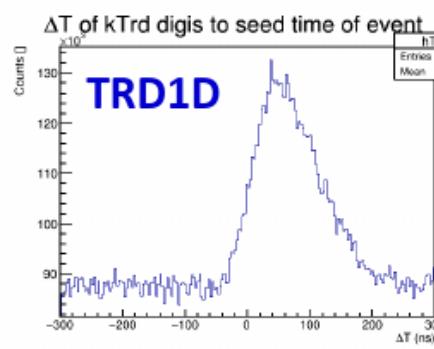
Mean

-0.9968

STS

Counts [ ]

ΔT (ns)



ΔT of kTrd digis to seed time of event

hTDiffkTrd

Entries 1.825982e+07

Mean

6.344

Counts [ ]

hTDiffkTrd2D

Entries

638642

Mean

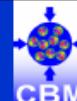
-5.671

ΔT of kTrd2D digis to seed time of event

Counts [ ]

ΔT (ns)

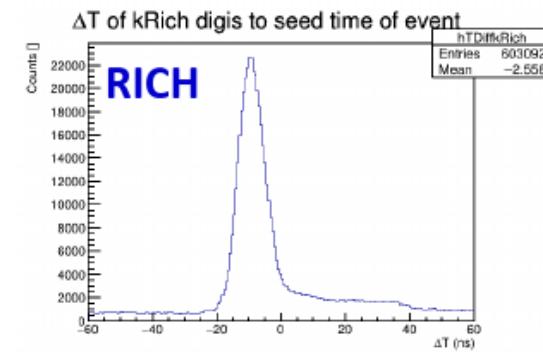
N. Herrmann, CBM Boards summary



Online selected digi events  
triggered with  
Tof-STS coincidences

C beam at 2A GeV

acquisition time: ~ 10 min



ΔT of kRich digis to seed time of event

hTDiffkRich

Entries 603092

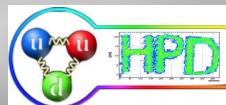
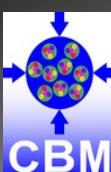
Mean

-2.558

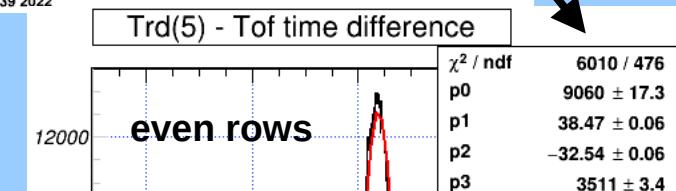
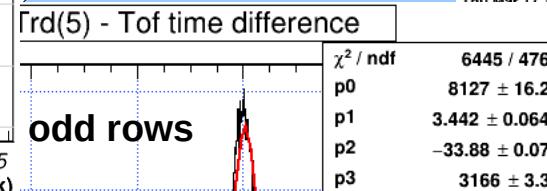
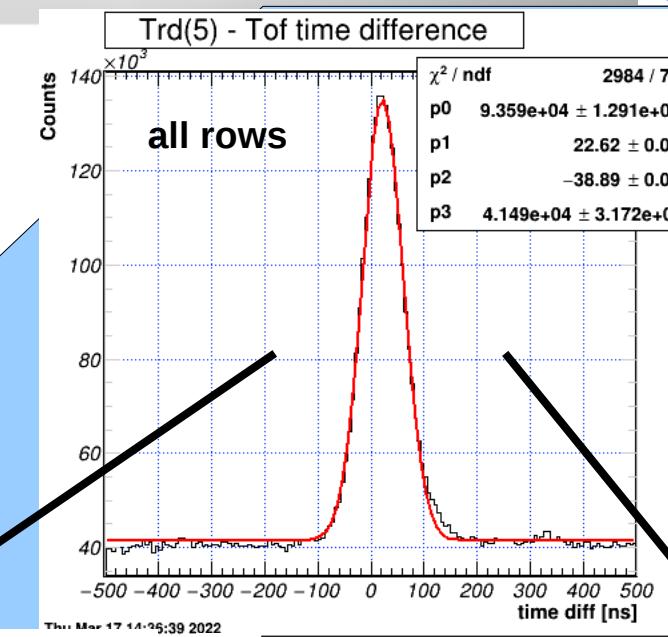
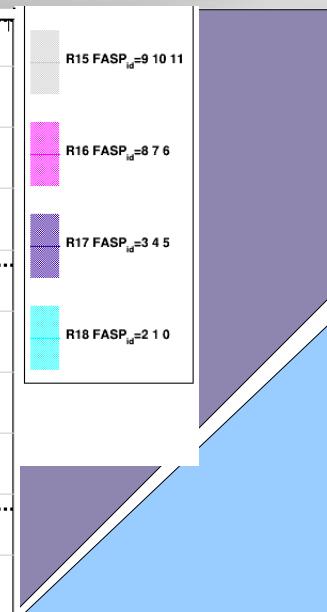
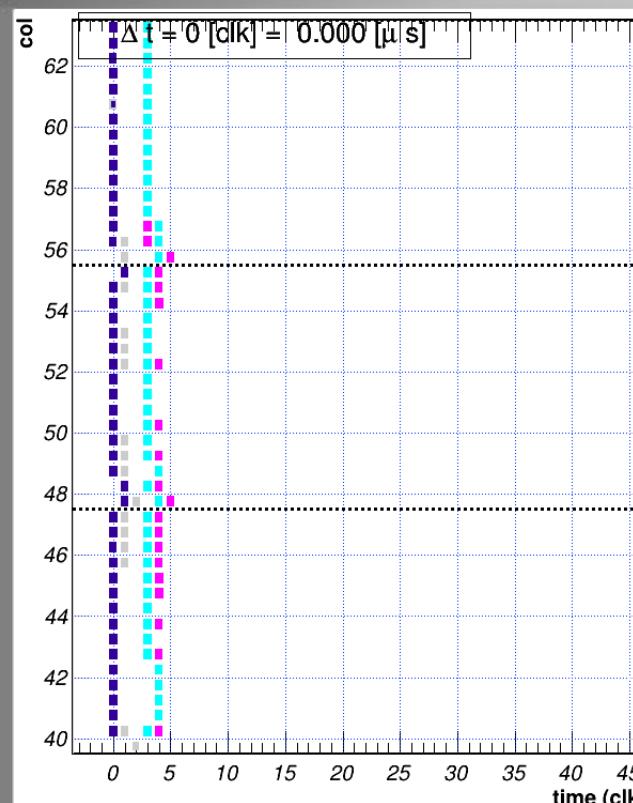
11.03.2022

N.Herrmann, CBM General Assembly, Mar 11, 2022

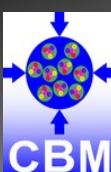
17



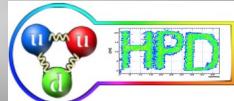
... a particularly beautiful result ...



18th March 2022



# Monitoring FASP-DAQ and .... detector shifts



The screenshot shows a Zoom meeting interface with a participant named Norbert Herrmann. The participant's screen is being shared, displaying a ROOT online server interface and a histogram titled "Faspid\_5-Digi\_Map".

**Zoom Meeting Participants:**

- Alexandru Bercuci (Me)
- Pierre-Alain Loizeau (FAIR) (Host)
- mcbmop06
- Christian Sturm (Co-host)
- David Schleidt

**Chat History:**

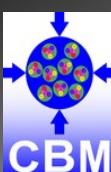
- DE: Did LGAD and diamond use the same bias HV supply?
- DE: Or did we use a different HV PSU for the LGAD?
- DE: Is diamond now connected to the brown HV?
- DE: I wonder if the HV cables were moved in the DAQ container between LGAD and diamond HV PSU ...
- CBM MUCH to Everyone: 03:40 AM
- CM: What is the beam energy ?
- Claudio Schiaua to Everyone: 03:43 AM
- CS: TRD2D small chamber HV off
- David Schleidt to Everyone: 03:43 AM
- DS: TRD1D HV off
- Who can see your messages?

**ROOT online server interface:**

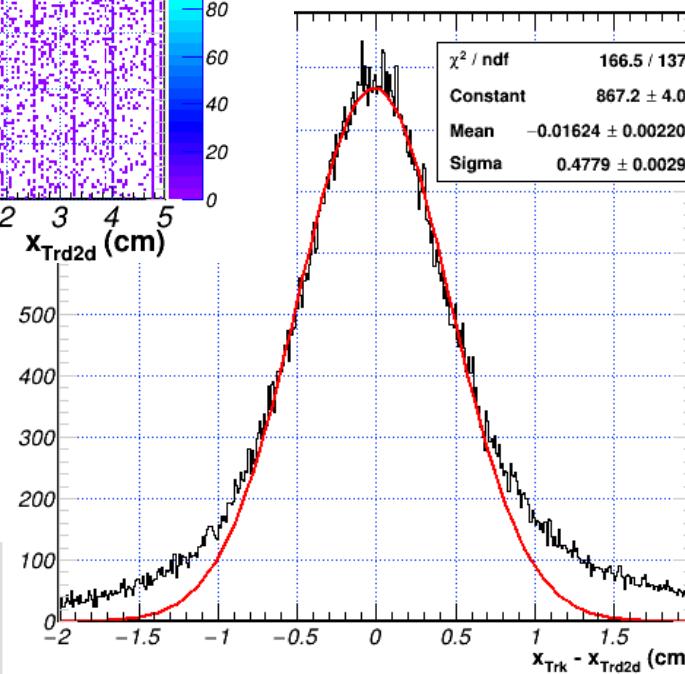
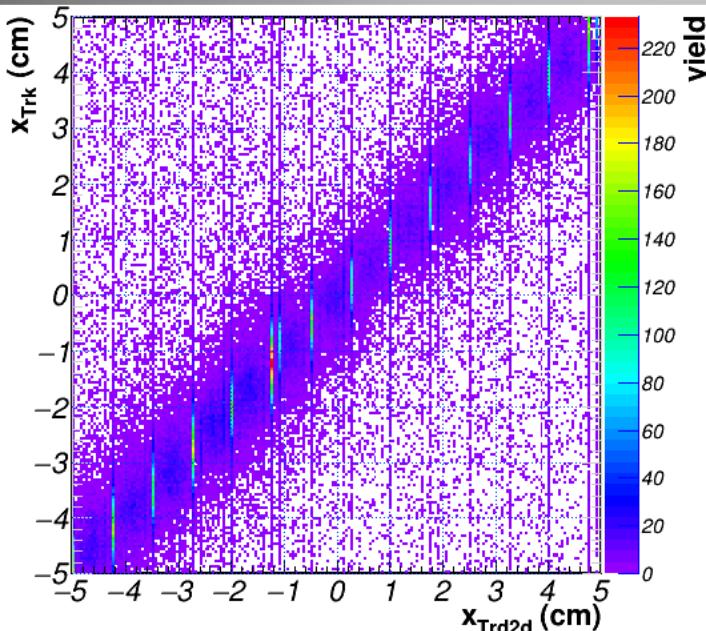
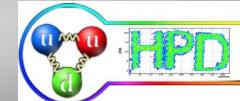
- JSROOT version ROOT 6.16.00
- Hierarchy in **json** and **xml** format
- Monitoring: simple
- open all | close all | reload | clear
- ROOT
  - rich
    - Reset\_UnpRich\_Hist
  - sts
    - Reset\_UnpSts\_Hist
  - Objects
    - 5
      - Digi
        - ModuleId\_5-Digi\_Map
        - ModuleId\_5-Digi\_Map\_St
        - ModuleId\_5-Digi\_Map\_Nt
        - ModuleId\_5-Digi\_Charge
        - ModuleId\_5-Digi\_Charge\_St
        - ModuleId\_5-Digi\_Charge\_Nt
        - ModuleId\_5-Digi\_Channel
        - ModuleId\_5-Digi\_Channel\_N
        - ModuleId\_5-Digi\_TriggerType
        - ModuleId\_5-Digi\_DigitDeltaT
        - Faspid\_5-Digi\_Map
        - Faspid\_5-Digi\_Charge
        - Faspid\_5-Digi\_Channel
        - Faspid\_5-Digi\_DigitDeltaT
  - Raw
  - Other
  - 21
  - 37
  - 53

**Faspid\_5-Digi\_Map Histogram:**

The histogram shows a 5x5 grid of pads with a total area of  $18 \times 21.6 = 388.8 \text{ cm}^2$ . The x-axis is labeled "COL (pad)" and ranges from 0 to 70. The y-axis ranges from 0 to 18. The color scale on the right indicates signal strength from 0 (blue) to 200 (yellow). The histogram shows several high-intensity regions, with a prominent central cluster and smaller clusters along the edges.



# mCBM 2021 reconstruction



Anode wire identification was not proved yet @ mCBM probably due to some shortcomings in the signal processing

## Global space-time correlation of the local Trd reconstruction within the mCbm environment \*

A. Bercuci<sup>1</sup>, D. Emschermann<sup>5</sup>, P. Kathler<sup>2</sup>, A. Punko<sup>2</sup>, P. Raisig<sup>3</sup>, F. Roether<sup>3</sup>, C. Schiava<sup>1</sup>, and D. Schleidt<sup>4</sup>

<sup>1</sup>IFIN-HH, Bucharest, Romania; <sup>2</sup>WWU, Muenster, Germany; <sup>3</sup>IKF, Frankfurt, Germany; <sup>4</sup>IRI, Frankfurt, Germany; <sup>5</sup>GSI, Darmstadt, Germany

Four Trd modules, (see Fig. 1) having geometries and Front End Electronics (FEE) close to those proposed for the CBM experiment [1][2], were operated in the mCBM test facility at SIS18 at GSI Germany. They were installed between the Sts and Tof detectors as in the final experiment, acting as intermediate tracking devices.



Figure 1: The Trd setup at mCBM 2021 comprising four modules: Trd-2d, Trd-2dh and two Trd-1d modules.

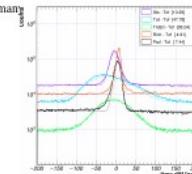


Figure 2: Time differences within a TS between Tof soft-trigger and raw data measured with the rest of mCBM components; time resolution determination is emphasized by the dashed-line fit in each case.

each system, the distribution has two components: a flat background of uncorrelated data and a Gaussian signal of time differences of event correlated measurements. The model is shown in Fig. 2 by a dashed line for each case and its deviations from measurements are to be further investigated. An event time-resolution can also be derived for each system (see figure legend) and such value positively compare with realistic simulations of the experimental setup. For the case of Trd-1d the time-resolution is drastically limited by not using the digital features of the SPADIC ASIC, but only the rough ADC sample timing.

The time correlations, as shown in Fig. 2, are used to calibrate and define *time-windows* for raw-event reconstruction. Such selection is used to force a local system cluster/hit reconstruction apply only on the sub-set of time selected data. The efficiency and bias of such procedure is under investigation on detailed simulations but a first test can be already performed on data by following the spatial correlation between several systems.

## Time correlations, raw-event selection

A close to final DAQ was tested for the first time during the mCBM '21 campaign driven by a common clocking scheme (the TFC [3]) steering all participating systems. A trigger-less data stream imposes challenges also on the data analysis as time-dimension became instrumental in data reconstruction. A hybrid event definition was developed [4] based on a Tof soft trigger constructed out of selected data. Such trigger is checked against each data from the rest of the detectors within a *time-slice* (TS).

The time correlations are shown in Fig. 2 for all mCBM'21 systems: Sts, Trd-1d, Trd-2d, Rich and Psd. For

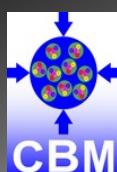
\* Work supported by Romanian Ministry of Research, Innovation and Digitization NUCLEU Project Contract PN-10060103, RO-FAIR Project FAIR-03/16.1.1/2020, BMBF grant 05P19PMPFC1 and 05P21PMPFC1 and BMBF grant 05P19RFFC1 and 05P21RFFC1.

<sup>1</sup>A time interval defined by the DAQ of continuous read-out packing.

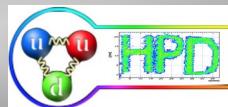
## Spatial correlations, local reconstruction

Testing the raw-event selection procedure with data is in progress [4]. From a Trd perspective, a possible test is to extend the time selection to those events with *only* two hits in both the Sts and Trd systems. Further constraints are imposed on the hits being measured in different modules of each system. A linear interpolation is performed on the four spatial points, mimicking the particle trajectory, and its intersects with the fiducial volumes of the Trd modules consequently estimated.

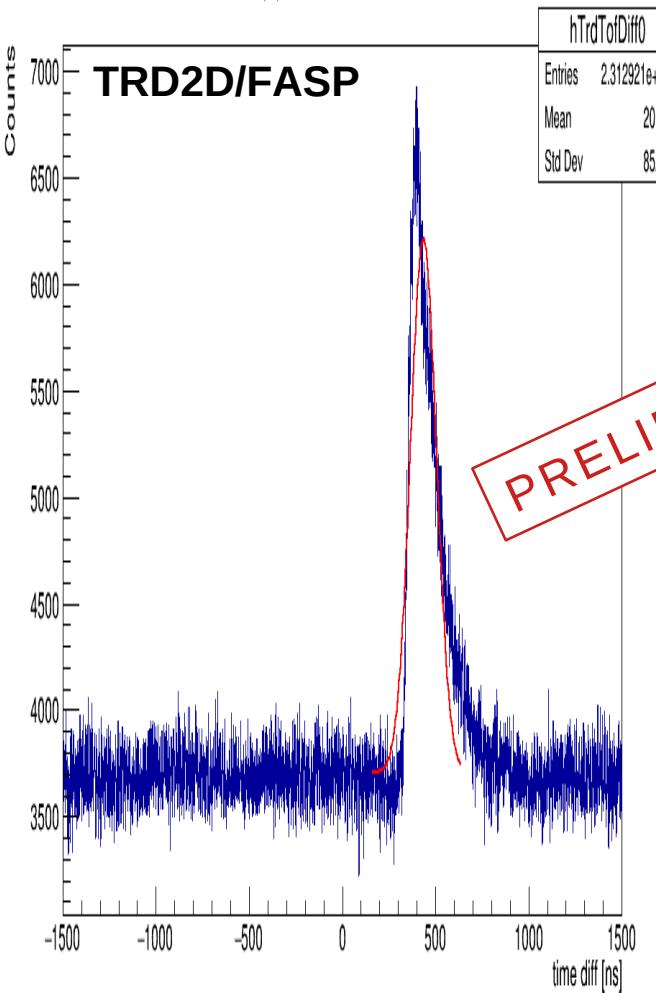
A. Bercuci et al., *Global space-time correlation of the local Trd reconstruction within the mCbm environment*, CBM Progress Report 2021, in preparation



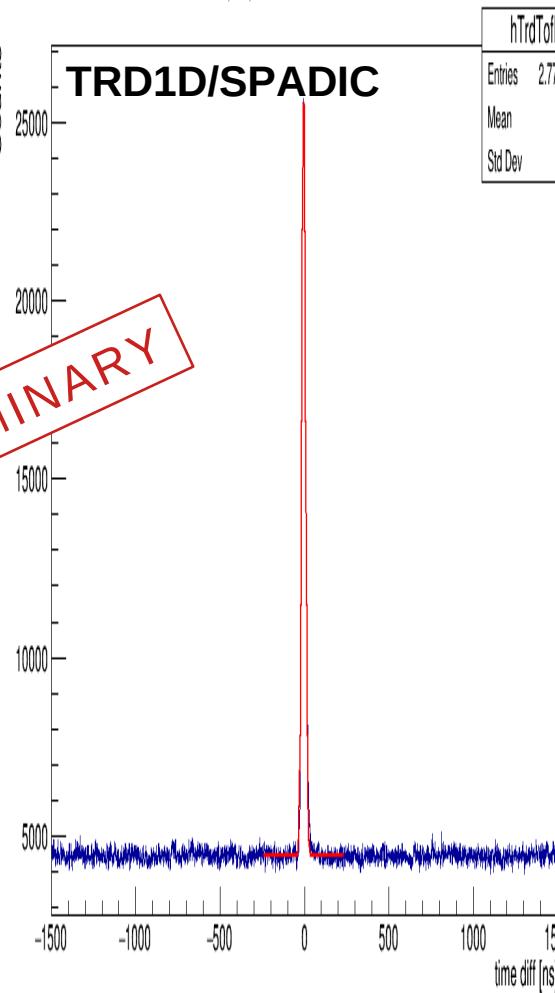
# mCBM '21-'22 simulations (A. Nan)



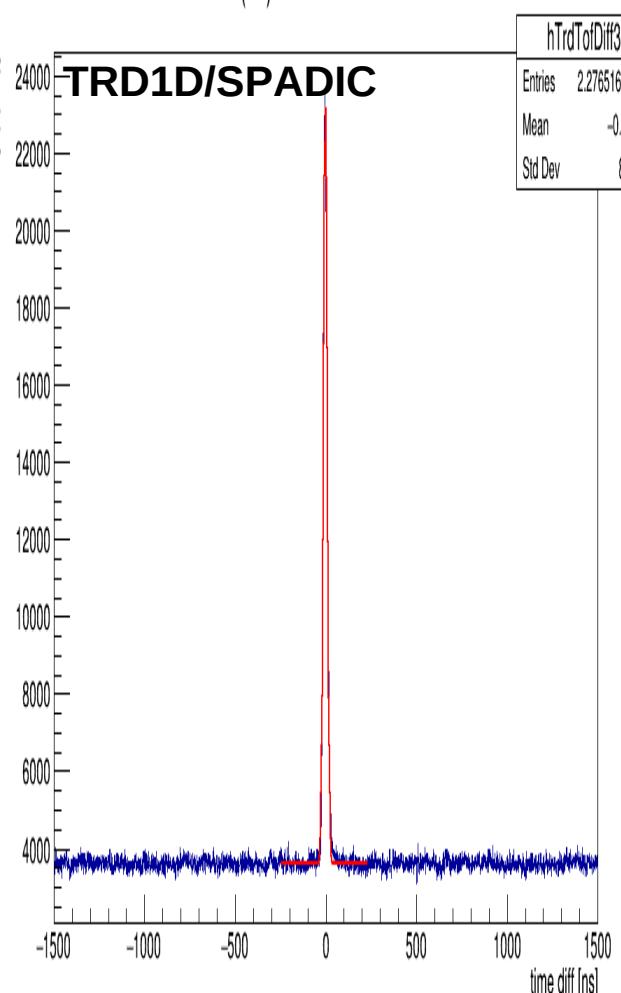
Trd(5) - Tof time difference

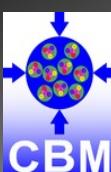


Trd(37) - Tof time difference

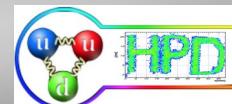


Trd(53) - Tof time difference

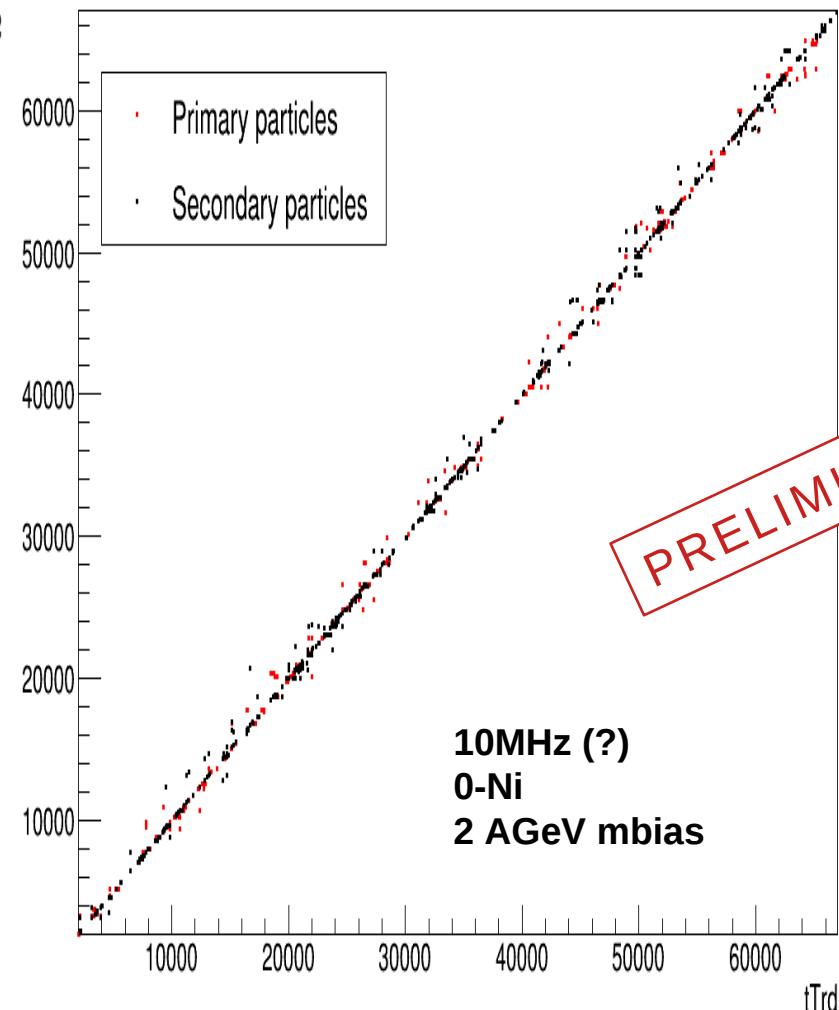




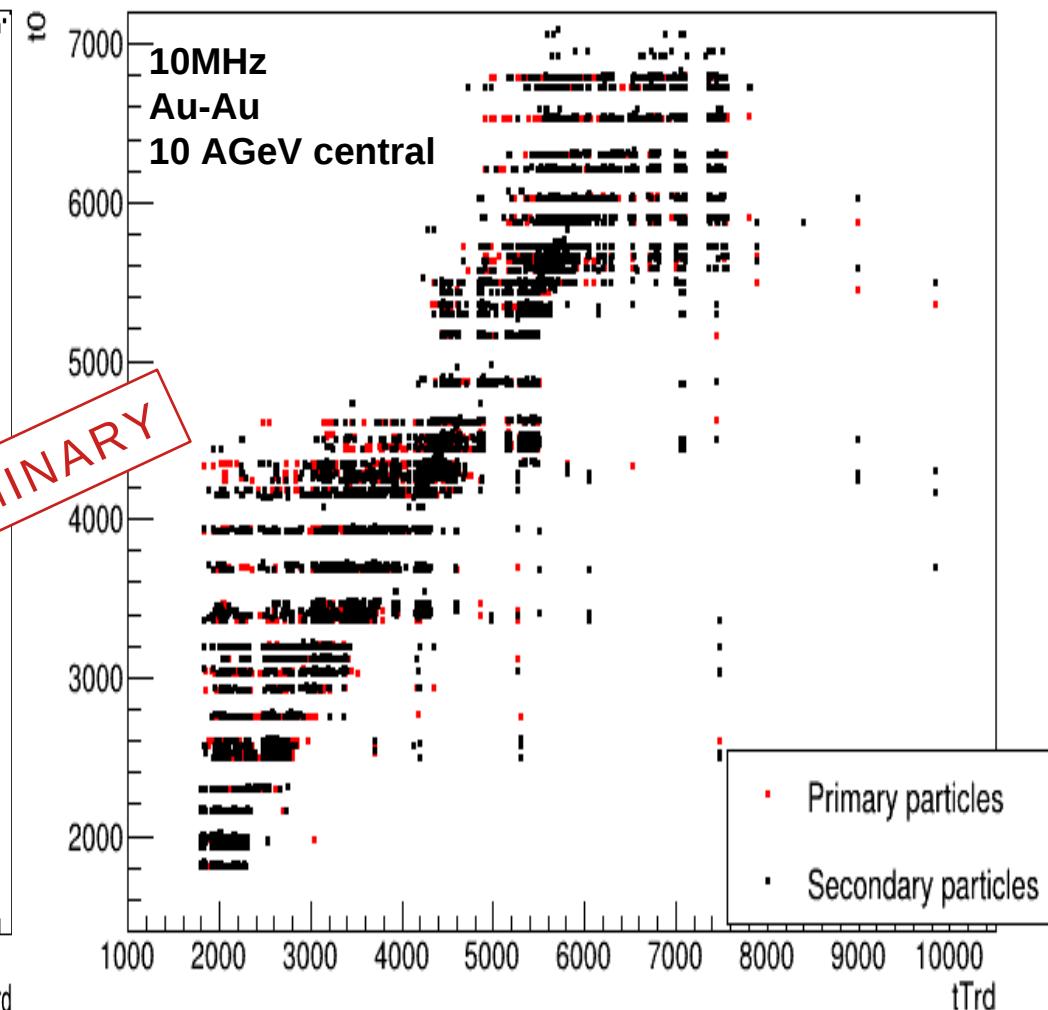
# mCBM '21-'22 simulations (A. Nan)

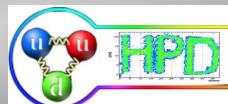
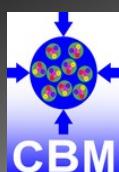


Plot Hit Correlations

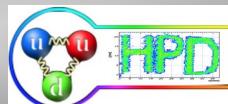
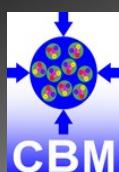


Plot Hit Correlations



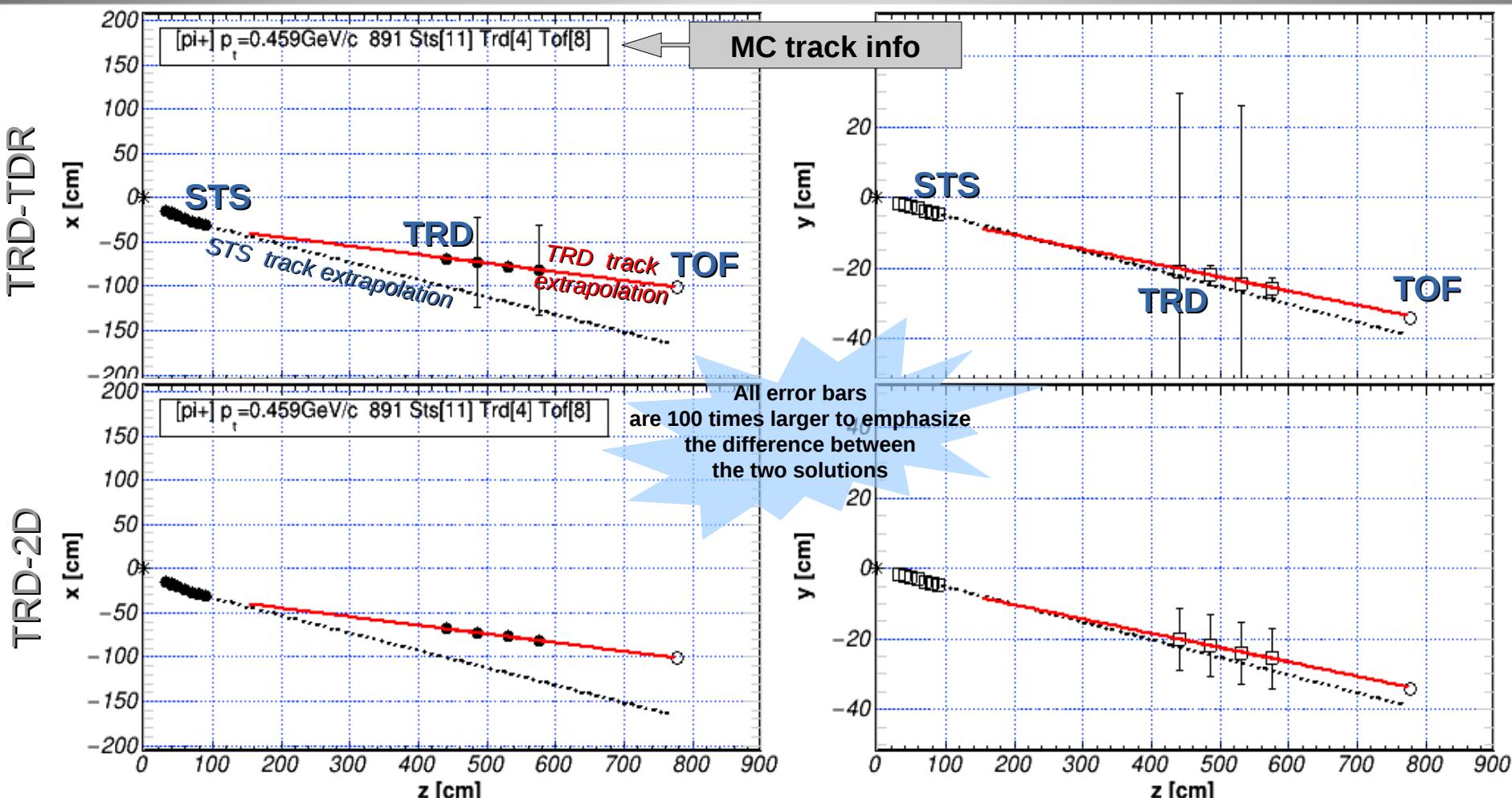


# Thank You !



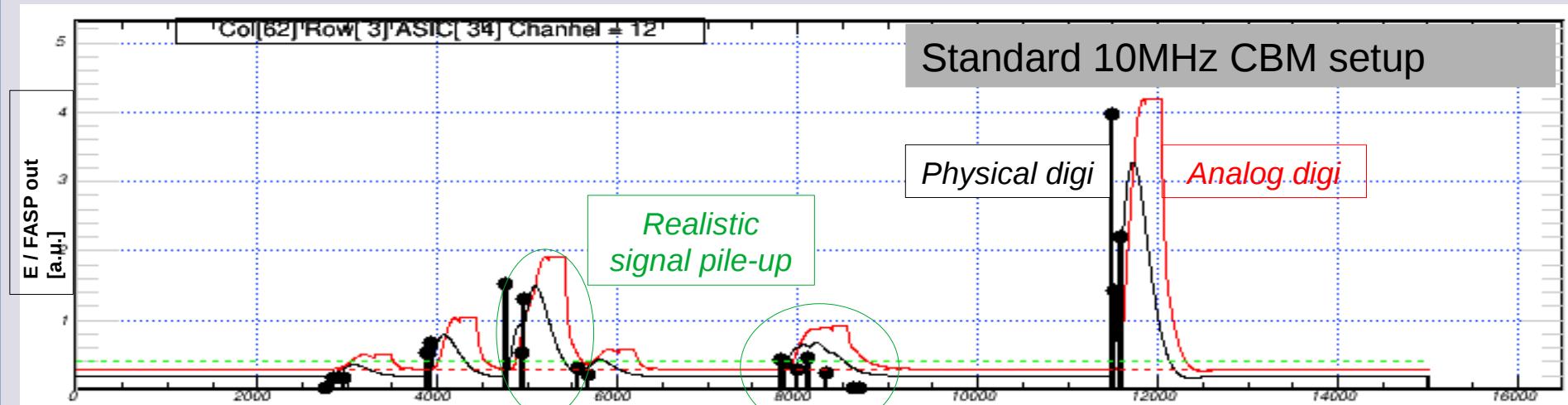
# BACKUP

# Standalone/complementary TRD tracking



**TRD track extrapolation** : linear fit of ideally reconstructed TRD hit extrapolated to STS and ToF ( $z$  of MC point)  
 → see next slide for ideal reconstructed TRD hit definition

## CbmRoot integration : Digitization → Reconstruction → Tracking → Physics



## From 2D position resolution to tracking efficiency in SIS100 set-up EbyE simulations.

